Deriving the Speed of Light from the Expansion of Time and Space: A GUFT Perspective

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Abstract

We propose a novel framework in which the speed of light c is not a fundamental constant, but rather a derived quantity arising from the asymmetric expansion of both space and time. By introducing temporal scale factors alongside spatial ones, and grounding both in the dynamics of the Dark Energy Quantum Field (DEQF) as formulated in the Grand Unified Field Theory of Asymmetry (GUFT), we demonstrate that c can be expressed as a ratio of temporal to spatial expansion coefficients. We also explore how c defines the rate at which all matter moves through time and how it relates to the cosmological constant Λ as orthogonal projections of the DEQF. This framework leads to a deeper understanding of cosmological fine-tuning and invites testable predictions regarding time dilation and frame dependence.

1. Introduction

The speed of light c has long been treated as a fundamental constant, postulated in the structure of both Maxwellian electrodynamics and Einstein's theory of relativity. However, the true origin of its value remains unexplained. In this paper, we explore the hypothesis that c emerges from a more fundamental structure—the asymmetric expansion of time and space as phase projections of the Dark Energy Quantum Field (DEQF), within the Grand Unified Field Theory of Asymmetry (GUFT).

2. Temporal Expansion as a Dynamical Quantity

In standard cosmology, only space expands, characterized by the scale factor $a(t)$. Time is treated as a coordinate parameter, not a dynamical dimension. We extend this framework by introducing a temporal scale factor $b(t)$, representing the expansion of temporal intervals themselves.

We propose a modified line element:

$$ds^2 = -b(t)^2dt^2 + a(t)^2dx^2 + a(t)^2dy^2 + a(t)^2dz^2 \tag{1}$$

For light-like intervals ($ds^2 = 0$), this yields:

$$b(t)^2dt^2 = a(t)^2dx^2 \quad \Rightarrow \quad \left(\frac{dx}{dt}\right)^2 = \left(\frac{b(t)}{a(t)}\right)^2 \tag{2}$$

Hence, the speed of light becomes:

$$c(t) = \frac{b(t)}{a(t)} \tag{3}$$

In our current epoch, observations suggest c is constant, implying:

$$\frac{b(t)}{a(t)} = \text{const} \quad \Rightarrow \quad b(t) \propto a(t) \tag{4}$$

3. Motion Through Time at the Speed of Light

It is a well-established result in relativity that all objects move through spacetime at the speed c. A massive object at rest in space is said to be moving entirely through time, while objects in motion through space divert some of their trajectory through time into the spatial dimensions. This interpretation suggests that c is not only the maximum speed of light, but the intrinsic rate at which matter progresses through time-space.

Thus, any deviation from pure temporal motion (i.e., an object at rest) introduces a spatial momentum component, reducing its rate of motion through time. This conceptual model reinforces the view of c as a velocity vector norm in Minkowski space:

$$v^2 + (c \cdot \tau)^2 = c^2 \tag{5}$$

where τ represents proper time progression.

4. DEQF Pressure and the Origins of c and Λ

In GUFT, the DEQF serves as the fundamental substrate of reality. We postulate that both c and Λ arise as static directional pressures of the DEQF:

- c: the rate at which the DEQF pushes forward the envelope of time, giving rise to temporal flow.
- Λ: the rate at which the DEQF applies static pressure on the spatial geometry, leading to accelerated cosmic expansion.

Thus,

$$c = \frac{\gamma_x}{\gamma_t}, \qquad \Lambda = f(\gamma_x) \tag{6}$$

This suggests that both constants are not independent but are orthogonal projections of the same DEQF field dynamics.

5. DEQF Coupling and Asymmetric Projection

According to GUFT, all observable fields are phase states of the DEQF. Let Φ represent the DEQF field intensity. We define:

$$\Delta x = \gamma_x \Phi \tag{7}$$

$$\Delta t = \gamma_t \Phi \tag{8}$$

where:

- γ_x is the spatial coupling constant
- γ_t is the temporal coupling constant

Thus,

$$c = \frac{\Delta x}{\Delta t} = \frac{\gamma_x}{\gamma_t} \tag{9}$$

This formulation positions c as the emergent ratio between asymmetric phase couplings of the DEQF.

6. Implications and Testable Predictions

This derivation implies:

- If γ_x or γ_t varied in the early universe, c would have varied accordingly, aligning with varying speed of light (VSL) cosmologies.
- Λ and c can be tested as projections of the same underlying pressure field through observational comparisons of cosmic acceleration and time dilation.
- Empirical tests could involve reinterpreting redshift-distance relations using a dynamic $b(t)$.

7. Conclusion

We have shown that if both time and space are emergent from the same DEQF framework and expand asymmetrically, then the speed of light c naturally arises as their ratio. Furthermore, c and Λ can be interpreted as directional pressures of the DEQF on time and space, respectively. This not only deepens our understanding of fundamental constants but invites fresh approaches to cosmological puzzles, including the passage of time, frame-dependent temporal evolution, and the origin of relativistic limits. Further development of GUFT and its field equations may provide a richer predictive framework to test these ideas.

References

- James Scott Trimm, *A Complete Formulation of the Grand Unified Field Theory of Asymmetry: Spacetime and Gravity as Emergent Phases of the Dark Energy Quantum Field*, July 7, 2025. Available at: `https://archive.org/details/guft-asymmetry-complete`